

WHAT IS CLAIMED IS:

5 1. A method of preparing a multi-domain, dry deposited liquid-crystal alignment layer, wherein said method is selected from the group consisting of: mechanical mask, photo-resist, UV treatment, and ridge and fringe field.

10 2. The method of claim 1, wherein said mechanical mask method comprises:
 depositing on a transparent conductive layer on a substrate a material to form a dry deposited layer;
 masking said dry deposited layer into first domain areas and second domain areas of the dry deposited
 15 layer with a mask; and
 selectively bombarding said dry deposited layer with an ion beam through said mask.

20 3. The method of claim 2, wherein said material is selected from the group consisting of: hydrogenated diamond-like carbon, amorphous hydrogenated silicon, silicon carbide (SiC), silicon dioxide (SiO₂), glass, silicon nitride (Si₃N₄), alumina (Al₂O₃), cerium(IV) oxide (CeO₂), tin oxide (SnO₂), zinc titanate (ZnTiO₂)
 25 and a combination thereof.

30 4. The method of claim 1, wherein said photo-resist method comprises:
 depositing on a transparent conductive layer on a substrate a material to form a dry deposited layer;
 partitioning said dry deposited layer into first domain areas and second domain areas of the dry deposited layer;

covering said first domain areas of said dry deposited layer with a mask leaving said second domain areas open;

bombarding said second domain areas with a second ion beam and removing said mask.

6. The method of claim 5, wherein said step of
15 covering comprises the step of applying a layer of
photo-resist.

7. The method of claim 1, wherein said UV treatment method comprises:

20 depositing on a transparent conductive layer on a substrate a material to form a dry deposited layer;

partitioning said dry deposited layer into first domain areas and second domain areas of the dry deposited layer;

25 selectively exposing one of said first and said second domain areas to UV light; and

bombarding both said first and said second domain areas with an ion beam in a single direction to produce in non-UV exposed domain areas a pretilt angle different from the areas that were exposed to UV light.

8. The method of claim 1, wherein said ridge and fringe field method comprises:

5 building a polymer ridge on said transparent
conductive layer on the color filter side;

10 bombarding said dry deposited layer with an ion
 beam under conditions to produce a low pretilt angle.

15 a bottom substrate having a first surface;
a first transparent conductive layer disposed over
said first surface of said bottom substrate;
a top substrate having a second surface;
a color filter layer disposed over said second
20 surface of said top substrate;

a first dry deposited liquid-crystal alignment layer over said first transparent conductive layer;

30 a plurality of uniformly sized transparent or non-transparent spacers distributed within said space; and

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wherein each of said first alignment layer and said second alignment layer is divided into a plurality of pixels each having a boundary and at least two domains; and wherein each of said multi-domain, dry deposited liquid-crystal alignment layers is obtained by a method selected from the group consisting of: mechanical mask, photo-resist, UV treatment, and ridge and fringe field methods.

10 10. The multi-domain, wide viewing angle liquid-crystal display of claim 9, wherein said domains of said first and said second dry deposited liquid-crystal alignment layers are obtained by mechanical mask method.

15 11. The multi-domain, wide viewing angle liquid-crystal display of claim 10, wherein said mechanical mask method comprises:

20 depositing on a substrate a material to form a transparent dry deposited alignment layer; masking said dry deposited layer into first domain areas and second domain areas of the dry deposited layer with a mask; and

25 selectively bombarding said dry deposited layer with an ion beam through said mask.

12. The multi-domain, wide viewing angle liquid-crystal display of claim 11, wherein said material is selected from the group consisting of: hydrogenated diamond-like carbon, amorphous hydrogenated silicon, silicon carbide (SiC), silicon dioxide (SiO₂), glass, silicon nitride (Si₃N₄), alumina (Al₂O₃), cerium(IV)

10 14. The multi-domain, wide viewing angle liquid-
crystal display of claim 9, wherein each of said pixels
have a first domain and a second domain.

16. The multi-domain, wide viewing angle liquid-crystal display of claim 15, wherein both of said first and said second dry deposited layers on said bottom and said top substrates have been bombarded.

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said first and said second dry deposited liquid-crystal alignment layers are obtained by photo-resist method.

19. The multi-domain, wide viewing angle liquid-crystal display of claim 18, wherein each of said pixels have a first domain and a second domain.

20. The multi-domain, wide viewing angle liquid-crystal display of claim 18, wherein said photo-resist method comprises:

depositing on a transparent conductive layer on a substrate a material to form a dry deposited layer;

partitioning said dry deposited layer into first domain areas and second domain areas of the dry deposited layer;

bombarding said dry deposited layer with a first ion beam; thereafter

covering said first domain areas of said dry deposited layer with a mask leaving said second domain areas open;

bombarding said second domain areas with a second ion beam; and

removing said mask.

21. The multi-domain, wide viewing angle liquid-crystal display of claim 20, further comprising: repeating the steps as needed.

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22. The multi-domain, wide viewing angle liquid-crystal display of claim 9, wherein said domains of said first and said second dry deposited liquid-crystal alignment layers are obtained by said UV treatment method.

23. The multi-domain, wide viewing angle liquid-crystal display of claim 22, wherein each of said pixels have a first domain and a second domain.

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24. The multi-domain, wide viewing angle liquid-crystal display of claim 22, wherein said UV treatment method comprises:

depositing on a transparent conductive layer on a
10 substrate a material to form a dry deposited layer;

partitioning said dry deposited layer into first domain areas and second domain areas of the dry deposited layer;

selectively exposing one of said first and said
15 second domain areas to UV light; and

bombarding both said first and said second domain areas with an ion beam in a single direction to produce in said non-UV exposed domain areas a pretilt angle different from the areas that were exposed to UV light.

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25. The multi-domain, wide viewing angle liquid-crystal display of claim 22, wherein said UV treatment method comprises:

depositing on a transparent conductive layer on a
25 substrate a material to form a dry deposited layer;

partitioning said dry deposited layer into first domain areas and second domain areas of the dry deposited layer;

selectively bombarding one of said first and said
30 second domain areas with an ion beam in a single direction; and

exposing both said first and said second domain areas to UV light to produce in said non-bombarded

domain areas a pretilt angle different from the areas that were bombarded with an ion beam.

26. The multi-domain, wide viewing angle liquid-crystal display of claim 9, wherein said domains of said first and said second dry deposited liquid-crystal alignment layers are obtained by said ridge and fringe field method.

27. The multi-domain, wide viewing angle liquid-crystal display of claim 26, wherein said ridge and fringe field method comprises:

building a polymer ridge on said transparent conductive layer on the color filter side;

depositing on said surface of said transparent conductive layer a material to form a dry deposited layer; and

bombarding said dry deposited layer with an ion beam under conditions to produce a low pretilt angle.

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The multi-domain, wide viewing angle liquid-crystal display of claim 27, wherein said transparent conductive layer comprises indium tin oxide.

29. An improved method of preparing a liquid-crystal display of the type having the steps of forming a first dry deposited alignment layer, forming a second dry deposited alignment layer, spacing the first dry deposited alignment layer and the second dry deposited alignment layer adjacent to and facing each other and filling a liquid-crystal material in the space therebetween, wherein the improvement comprises the steps of:

forming a first multi-domain dry deposited alignment layer;

forming a second multi-domain dry deposited alignment layer;

5 spacing said first multi-domain dry deposited alignment layer and said second multi-domain dry deposited alignment layer adjacent to and facing each other; and

10 filling a liquid-crystal material in the space therebetween;

wherein each of said multi-domain, dry deposited liquid-crystal alignment layers is obtained by a method selected from the group consisting of: mechanical mask, photo-resist, UV treatment, and ridge and fringe field.

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30. An improved method of preparing an in-plane switching mode liquid-crystal display of the type having the steps of forming a first polyimide alignment layer and a second polyimide alignment layer, wherein
20 each of the first and second layers is rubbed with a mechanical roll wrapped in a velvet cloth, wherein the improvement comprises the steps of:

forming a first dry deposited alignment layer;

forming a second dry deposited alignment layer;

25 spacing said first dry deposited alignment layer and said second dry deposited alignment layer adjacent to and facing each other; and

filling a liquid-crystal material in the space therebetween;

30 wherein each of said dry deposited liquid-crystal alignment layers is obtained by a method selected from the group consisting of: mechanical mask, photo-resist, UV treatment, and ridge and fringe field.

31. A wide viewing angle in-plane switching mode liquid-crystal display, comprising:
- a bottom polarizer;
 - 5 a bottom substrate;
 - a top polarizer;
 - a top substrate;
 - a color filter layer disposed over a surface of said top substrate;
 - 10 a plurality of common electrodes disposed in the bottom substrate plane and a plurality of pixel electrodes disposed in a staggering relationship therewith to form a comb-like structure for producing an electric field parallel to plane of said bottom
 - 15 substrate so that when when operated, the molecules of said liquid-crystal material are switched to rotate by said vertical electric field in a direction parallel to the substrate surface;
 - a first dry deposited liquid-crystal alignment
 - 20 layer over said bottom substrate and said comb-like electrodes;
 - a second dry deposited liquid-crystal alignment layer over said color filter layer; said second dry deposited liquid-crystal alignment layer being spaced
 - 25 adjacent to and facing said first dry deposited liquid-crystal alignment layer;
 - a plurality of uniformly sized transparent or non-transparent spacers distributed within said space; and
 - a liquid-crystal material disposed in the space
 - 30 therebetween.

32. The liquid-crystal display of claim 31, wherein said method of obtaining each of said dry

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deposited liquid-crystal alignment layers comprises:
treating a dry deposited layer with an ion beam in a
direction making from about 10 to about 20 degree angle
with the plane of the electrodes.

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33. The liquid-crystal display of claim 31,
wherein each of said common electrodes on one end is in
communication with a storage capacitor, wherein each of
said pixel electrodes is in communication on one end
10 with said storage capacitor and on the other end with a
thin film transistor, said thin film transistor being
in communication with a data bus line and a gate bus
line.

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